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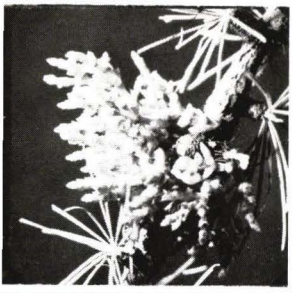

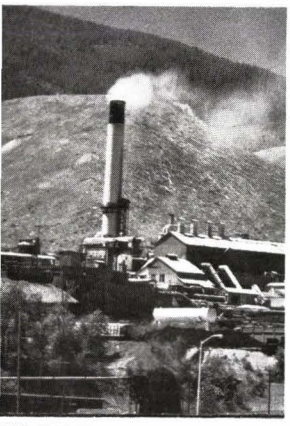

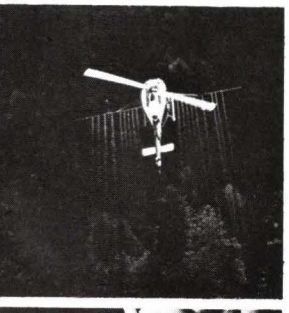

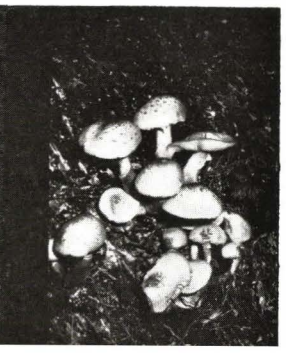

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POTENTIAL FOR INFESTATION BY MOUNTAIN PINE BEETLE IN LODGEPOLE PINE STANDS, HUNGRY HORSE DISTRICT, FLATHEAD NATIONAL FOREST, 1977

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ABSTRACT

Ground surveys on the Hungry Horse District indicate a potential for mountain pine beetle infestation in lodgepole pine. Based on elevation-latitude, mean d.b.h. and phloem thickness, and age, stands were given a susceptibility classification of high risk. An infestation in Glacier National Park may provide the beetle source. Management alternatives are discussed and long-term management goals are recommended.

INTRODUCTION

Mountain pine beetle (*Dendroctonus ponderosae* Hopk.) infestations are widespread throughout lodgepole pine (*Pinus contorta* var. *latifolia* Engelm.) stands in the Northern Region. Aerially visible infestation in 1976 exceeded 399,439 ha (Bousfield and Carlson, In Press). Few acres of lodgepole pine are currently infested on the Hungry Horse District, but a potential for infestation exists. In nearby Glacier National Park (figure 1), infestation occurs on 40,419 ha (Hamel et al. 1977). A biological evaluation was conducted on the District in December 1976 to determine the potential for increased infestation.

Ground surveys were conducted near the Challenge Guard Station, Middle Fork Flathead River drainage (figure 1), to determine stand composition, age, elevation, mean tree size, and phloem thickness. Based on these measurements, a hazard rating for attack by mountain pine beetle was calculated.

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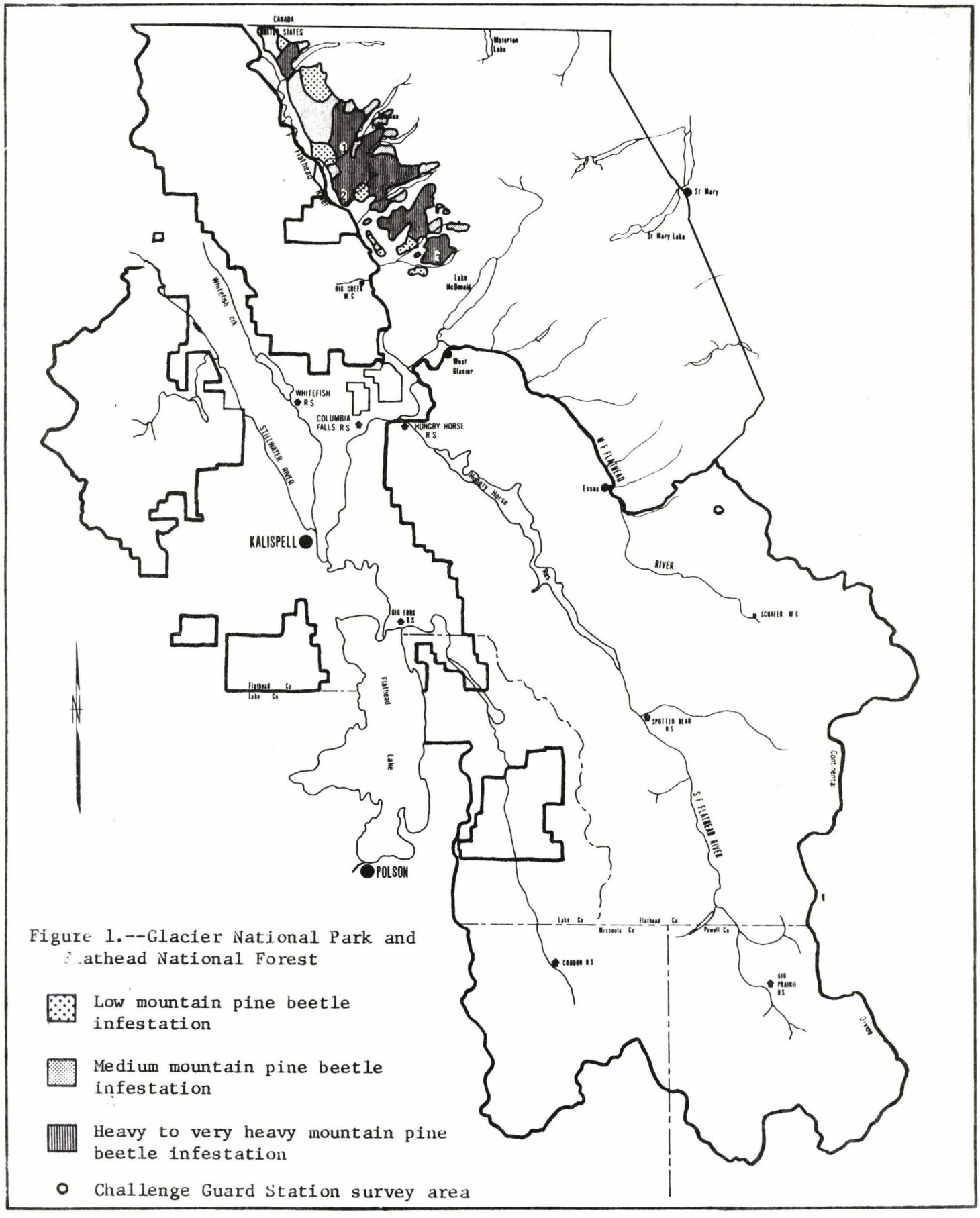

Figure 1.--Glacier National Park and Flathead National Forest

METHODS

Forty 1/25-ha plots were established at 5-chain (100 m) intervals on lines at 100 m intervals in lodgepole pine stands. Hypsometers were used to determine if trees fell within plot boundaries. All green trees were recorded by species and diameter at breast height (d.b.h) to the nearest centimeter. Estimates of phloem thickness for each diameter class were obtained from bark samples removed from opposite sides of each tree. Phloem thickness was measured to the nearest 0.25 mm.

RESULTS

Habitat type is *Abies lasiocarpa/Xerophyllum tenax* phase *Vaccinium scoparium* (Pfister et al. 1974). Elevation is 1,524 m. Stand composition is lodgepole pine 55 percent; Engelmann spruce 29 percent; and subalpine fir 16 percent. Mean diameters and stocking levels by species are presented in table 1.

Table 1.--Green stand composition, Challenge Guard Station area, Hungry Horse District, Flathead NF, 1977.

Tree species	% of stand	Mean d.b.h.(cm)	Trees/ hectare
Lodgepole pine	55	30.2	484
Spruce	29	21.8	255
Subalpine fir	16	18.0	138

Mean diameter of lodgepole pine is 30.2 cm. Mean phloem thickness ranged from 0.13 cm for trees 12.7 cm d.b.h. to 0.23 cm for trees 45.7 cm and greater d.b.h. (table 2). Mean phloem thickness for all size classes was 0.20 cm.

DISCUSSION

Epidemics of mountain pine beetle in lodgepole pine are directly related to site quality, age, phloem thickness, tree diameter distributions within the stand, and elevation and latitude (Amman 1969; 1972; Amman et al. In Press). Stands on better sites become susceptible more rapidly than those on poor sties. Infestations seldom develop in stands less than 60 years of age. In stands 60-80 years old, a larger proportion of trees are reaching phloem thickness/tree diameters conducive to outbreaks. Stands greater than 80 years old present the greatest potential for infestation.

Table 2.--Summary of phloem measurements, Hungry Horse District, Flathead NF, 1977.

d.b.h. (in cm)	Mean phloem thickness (in cm)
12.7	0.13
15.2	.14
17.7	.15
20.3	.16
22.8	.17
25.4	.19
27.9	.20
30.4	.20
33.0	.22
35.5	.21
38.1	.22
40.6	.20
43.1	.22
45.7	.11
48.2	.22
50.8	.23
53.3	.22
55.8	.23

Mountain pine beetle kills proportionately more large than small diameter trees and generally kills the larger diameter trees during each successive year of a major infestation. Larger trees generally have thicker phloem, and produce more beetles per cm^2 than small diameter, thin-phloem trees (Amman 1972). Beetle production is less in dense stands, which usually have trees with thinner bark and phloem ($\leq$ 0.25 cm). As larger diameter trees ($\geq$ 20 cm d.b.h.) with thick phloem ($\geq$ 0.25 cm) are depleted, infestations begin to decline (Amman et al. In Press; Cole and Amman 1969; Safranyik et al. 1974).

Hazard rating systems for lodgepole pine stands to estimate potential for infestation by mountain pine beetle are available (Amman et al. In Press, Safranyik et al. 1974). Amman et al. (In Press) uses age, elevation, and average d.b.h. for stand rating. Stands in general must be $\geq$ 80 years of age, located at an elevation where climate is favorable for brood development, and the average d.b.h. of the stand $\geq$ 12.7 cm must exceed 20 cm. These factors were used in hazard rating the evaluated stands. By multiplying the following risk factors (1 = low; 2 = moderate; 3 = high) for elevation-latitude, age, and mean d.b.h., susceptibility classification of the stand is obtained: low = 1-9; moderate = 12-18; high = 27.

Average age	Elevation-latitude	Mean d.b.h.(cm)
$<$ 60 (1)	High (1)	$<$ 17.8 (1)
60-80 (2)	Moderate (2)	17.8-20.3 (2)
$>$ 80 (3)	Low (3)	$>$ 20.3 (3)

In the stands examined, elevation is low (1,524 m), average age of lodgepole pine > 120 years, and average d.b.h. is 30.2 cm, the overall rating (3x3x3) is 27, or high hazard for infestation.

Stands which show a high probability of infestation and subsequent loss require management planning prior to becoming infested. There are about 12,950 ha in the area where timber values are primary. There are several alternatives for dealing with impending beetle infestations.

Since mountain pine beetle concentrates heavily on large diameter trees, continuous lodgepole pine forests can be broken up by small clear cuts that will result in different age and size classes and reduce the area likely to be infested at any one time. When residual patches reach high risk conditions, the patch could be harvested immediately. This management alternative could be planned many years in advance.

Because mountain pine beetle shows preference for large diameter trees, partial cuts will greatly reduce infestation potential. Removal of trees $\geq$ 20.3 cm d.b.h. will "beetle proof" most stands.

Harvesting trees before they reach susceptible age and size is an effective method of preventing losses; however, in this area, most stands have already reached this class.

Another alternative for susceptible stands is to favor nonhost trees.

In areas where spruce and subalpine fir represent 45 percent of the stands, these species could be favored in partial cuts. Their presence will result in greater residual stocking should an epidemic occur. Conversion to another species (spruce or subalpine fir) may result in depredations by Engelmann spruce beetle (*Dendroctonus rufipennis* (Kirby)) or western balsam bark beetle (*Dryocoetes confusus* Swaine), however.

Silvicultural treatment is not viable where other values are primary (e.g. proposed Great Bear Wilderness area). In such areas, the proportion of other species will increase if the mountain pine beetle infests the stands. In seral lodgepole pine forests, succession in the absence of fire will eventually eliminate both lodgepole pine and mountain pine beetle. A no treatment policy would create a "beetle reservoir" where beetles could breed, and infest managed stands.

Potential losses from mountain pine beetle can be lessened by reducing stand susceptibility through formulating and implementing: (1) long-term management goals and silvicultural procedures, and (2) planned harvesting for stands risk rated high.

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